

## Dateline Los Alamos: Top science news of 2014

December 22, 2014



### ***Biosurveillance, secure computing, alternative energy, unique capabilities highlight the year***

LOS ALAMOS, N.M., Dec. 22, 2014—Los Alamos National Laboratory today announced its annual top science stories of 2014. The 12 stories selected from diverse disciplines supporting Los Alamos's national security mission range from transferring fool-proof computer encryption techniques to market, to using social media for forecasting diseases, creating a virtual human body that could end animal drug tests, zeroing in on and modeling fossil fuel emissions and their impacts on the environment, ensuring that America's nuclear arsenal remains safe and ready, and even helping pave the way for human visitation to Mars.

“The breadth of scientific expertise and range of disciplines necessary for supporting Los Alamos’s national security mission can be seen when reflecting on some of the year’s more visible accomplishments,” said Alan Bishop, Principal Associate Director for Science, Technology and Engineering. “Los Alamos remains proud of its legacy of using world-class science to address some of the world’s most pressing and difficult problems.”

#### Using Wikipedia to forecast disease

A team of Los Alamos researchers determined that by analyzing views of Wikipedia articles, they could successfully monitor and forecast the spread of diseases around the globe in real time. Not only can such non-conventional disease surveillance improve the ways public-health officials respond to epidemics, but it can also provide a means for officials to plan for future outbreaks. The LANL team was able to successfully monitor influenza in the United States, dengue fever in Brazil and Thailand, and tuberculosis in China and Thailand using the novel technique, which will be used ultimately to build an operational disease monitoring and forecasting system with open data and open-source code.

<http://www.lanl.gov/discover/news-release-archive/2014/November/11.13-using-wikipedia-to-forecast-diseases.php>

#### ATHENA desktop human “body” reduces need for animal drug tests

Creation of surrogate human organs could revolutionize the way biologists and medical personnel screen new drugs or toxic agents. ATHENA, the Advanced Tissue-engineered Human Ectypal Network Analyzer project team, is developing four human organ constructs—liver, heart, lung and kidney—that are based on a significantly miniaturized platform. Each organ component will be about the size of a smartphone screen, and the whole ATHENA “body” of interconnected organs would fit neatly on a desk. The holistic dynamic system more realistically mimics the human physiological environment than static human cells in a dish, demonstrating chemical effects on human organs as never before.

<http://www.lanl.gov/discover/news-release-archive/2014/March/03.26-athena-desktop-human.php>

[https://www.youtube.com/watch?v=JVVeRtHLD5o&list=UUbWmiA\\_pHk9DE62BaSUFRw](https://www.youtube.com/watch?v=JVVeRtHLD5o&list=UUbWmiA_pHk9DE62BaSUFRw)

#### Los Alamos laser selected for Mars 2020 mission

Laser technology originally developed at Los Alamos National Laboratory has been selected for NASA’s new Mars mission in 2020. The SuperCam instrument will allow researchers to sample rocks and other targets from a distance using a laser. In addition to harnessing Los-Alamos developed Laser-Induced Breakdown Spectroscopy (LIBS) technology—which can determine the elemental composition of the target from more than 20 feet away—SuperCam adds another spectrum to its laser for Raman and time-resolved fluorescence spectroscopy: A technique partially refined at Los Alamos and the University of Hawaii that provides the molecular makeup of a target, therefore allowing geologists to determine mineralogy and search for organic materials. SuperCam represents a significant upgrade to the highly successful ChemCam instrument aboard the Curiosity rover, a rolling science laboratory that has helped researchers confirm the presence of water on Mars. Among other mission objectives, the Mars 2020 rover will help advance knowledge of how future human explorers could use natural resources available on the surface of the Red Planet.

<http://www.lanl.gov/discover/news-release-archive/2014/July/07.31-supercam-laser.php>

<http://www.nasa.gov/press/2014/july/nasa-announces-mars-2020-rover-payload-to-explore-the-red-planet-as-never-before/#.VIs2lkhOIXk>

<http://www.lanl.gov/discover/news-release-archive/2013/September/09.26-water-for-future-mars-astronauts.php>

Los Alamos hydrodynamic experiment provides key data for Stockpile Stewardship

In August at the Nevada National Security Site, Los Alamos researchers successfully completed Leda, an integrated experiment that provided important surrogate hydrodynamic materials data in support of the Laboratory's stewardship of the U.S. nuclear deterrent. Hydrodynamic experiments use non-nuclear materials that can mimic the properties of nuclear materials, providing insight into weapons performance in the absence of full-scale underground nuclear testing. Such hydrodynamic and sub-critical experiments are among the most useful multi-disciplinary technical activities that exercise the Laboratory's manufacturing capabilities, test scientific judgment, and enhance the competency of the Nevada workforce in areas of formality of underground and nuclear operations. Leda was an essential component in the National Nuclear Security Administration's Science Campaigns and Plutonium Sustainment Programs to support the technical basis for confidence in the nation's nuclear deterrent, and to support future stockpile stewardship.

<http://www.lanl.gov/discover/news-release-archive/2014/September/09.08-nevada-hydrodynamic-experiment.php>

<https://www.youtube.com/watch?v=vmsfgRtxbHg&feature=youtu.be>

Scientists detect methane levels three times larger than expected over Four Corners region

A team of researchers from Los Alamos, NASA and the University of Michigan reported the presence of higher-than-expected concentrations of methane, a potent greenhouse gas, over the Four Corners region of the Southwestern United States. Using remote sensing capabilities, the team found that the methane levels were nearly three times higher than what had been reported over the area by the Environmental Protection Agency. The researchers postulate that the discrepancy stems from methane escaping from underground coalmines in the area, which added to the levels that had been expected from two nearby coal-fired power plants. The research team believes the methane hotspot has existed over the region for nearly a decade.

<http://www.lanl.gov/discover/news-release-archive/2014/October/10.13-methane-hotspot.php>

<http://www.lanl.gov/discover/news-release-archive/2014/May/05.19-power-plant-emissions-verified-remotely.php>

Probing Fukushima with cosmic rays should help speed cleanup of damaged plant

Thanks to an agreement with Toshiba Corp. to license a novel technology refined at Los Alamos National Laboratory, Los Alamos scientists will be heading to Japan to set up a remote sensor that will allow nuclear scientists to peer inside the damaged reactors at the Fukushima Daiichi complex and get detailed pictures—without ever breaching the containment building. Muon tomography, a process that uses particles generated when cosmic rays interact with Earth's atmosphere to create pictures of dense objects, will show researchers high-resolution images of nearly all of the nuclear material inside the damaged reactor cores. The detailed images could allow plant

operators to more quickly develop and execute a cleanup strategy. Some estimate that muon tomography could help speed cleanup of the reactors by as much as a decade or more. The technology can also potentially reduce cleanup costs and worker exposure to radioactive materials.

<http://www.lanl.gov/discover/news-release-archive/2014/June/06.18-probing-fukushima-with-cosmic-rays.php>

[https://www.youtube.com/watch?v=qw\\_445aOefs](https://www.youtube.com/watch?v=qw_445aOefs)

Dark spaces could change the way we think about galaxies

By looking at the dark spaces between visible galaxies and stars, the NASA/JPL CIBER sounding rocket experiment has produced data that could redefine what constitutes a galaxy. CIBER, the Cosmic Infrared Background Experiment, is designed to understand the physics going on between visible stars and galaxies. Images of the night sky recorded in the near-infrared wavelength revealed some surprises for researchers, notably the brightness of many fluctuations that appear between stars and galaxies. These fluctuations are having us rethink what goes on between stars and galaxies. The data suggest that galaxies shed many more of their stars into the intervening space than was originally thought.

<http://www.lanl.gov/discover/news-release-archive/2014/November/11.07-unusual-light-in-dark-space-revealed.php>

[https://www.youtube.com/watch?v=psqoNL\\_glnA&feature=youtu.be](https://www.youtube.com/watch?v=psqoNL_glnA&feature=youtu.be)

World's largest single crystal of gold verified by Los Alamos instruments

Equipment and capabilities at Los Alamos National Laboratory's Lujan Neutron Scattering Center enabled a geologist to determine that a dazzling 217.78-gram piece of gold was in fact the world's largest single-crystal specimen—a distinguishing factor that would not only drastically increase its market value but also provide a unique research opportunity. Using the Lujan Center's HIPPO instrument, researchers probed the specimen with neutrons to gather critical information about the arrangement of atoms within the massive golden sample. HIPPO is a general-purpose powder diffractometer that measures both the crystal structure and orientation distribution of crystals (or texture) making up a poly-crystalline material from the powder pattern of the crystals. It is the only time-of-flight neutron instrument in the world that routinely measures texture, with single crystals being the ultimate textured samples.

<http://www.lanl.gov/discover/news-release-archive/2014/April/04.07-single-crystal-of-gold-verified.php>

<https://www.youtube.com/watch?v=mDXPQzTQ3SU>

Secure computing for the 'Everyman' goes to market

The largest information technology agreement ever signed by Los Alamos National Laboratory brings the potential for truly secure data encryption to the marketplace after nearly 20 years of development at the nation's premier national-security science laboratory. Quantum systems represent the best hope for truly secure data encryption because they store or transmit information in ways that are unbreakable by conventional cryptographic methods. By harnessing the quantum properties of light for generating random numbers, and creating cryptographic keys with lightning speed, the technology enables a completely new commercial platform for real-time encryption at high data rates. For the first time, ordinary citizens and companies will be able to use



cryptographic systems that have only been the subject of experiments in the world's most advanced physics and computing laboratories for real-world applications.

<http://www.lanl.gov/discover/news-release-archive/2014/September/09-02-secure-computing.php>

New rocket propellant and motor design offer high-performance and safety

Los Alamos National Laboratory scientists recently flight-tested a new rocket design that includes a high-energy fuel and a motor that also delivers a high degree of safety. Conventional solid-fuel rocket motors work by combining a fuel and an oxidizer, a material usually rich in oxygen, to enhance the burning of the fuel. In higher-energy fuels this mixture can be somewhat unstable, and can contain sensitive high explosives that can detonate under high shock loads, high temperatures, or other conditions. The new rocket fuel and motor design adds a higher degree of safety by separating the fuel from the oxidizer, both novel formulations that are, by themselves, not able to detonate. After years of development and bench-top static tests, the new rocket design was recently flight tested at the Energetic Materials Research and Testing Center's Socorro launch site, part of New Mexico Tech.

<http://www.lanl.gov/discover/news-release-archive/2014/October/10.23-rocket-design-flight-tested.php>

<https://www.youtube.com/watch?v=wwEVFVfvA50>

Insight into Alzheimer's, cancer, anemia gleaned from ribosome research

A groundbreaking study of the human ribosome by an international team of researchers, including scientists from Los Alamos National Laboratory, is revealing that the tiny molecular machine is far more versatile than previously understood. Minor changes in its sequencing can change its operation, allowing it to adapt to a changing environment. From a practical standpoint, these first studies of the atomistic mechanism of the human ribosome open a window into a range of diseases, from anemia, to cancer, to Alzheimer's disease. For more than a decade, Los Alamos has been successfully involved in applying computational approaches for modeling the structure and dynamic aspects of large and biologically important molecular machines such as the ribosome. Cracking the mechanism of human ribosomes could eventually aid health research, including enhancing the efficacy of antibiotics, about 50 percent of which target ribosomes; in addition, malformed human ribosomes are related to many different human diseases. It is within the ribosome, found in all living cells, that proteins are created, making the ribosome one of life's most fundamental machines.

<http://www.lanl.gov/discover/news-release-archive/2014/July/07.03-ribosome-research.php>

Complex systems influence melting of Greenland ice sheet

An international research team's fieldwork, drilling and measuring melt rates and ice sheet movement in Greenland is showing that things are, in fact, more complicated than we thought. Although the Greenland Ice Sheet initially speeds up each summer in its slow-motion race to the sea, the network of meltwater channels beneath the sheet is not necessarily forming the slushy racetrack that had been previously considered. Observations of moulins (vertical conduits connecting water on top of the glacier down to the bed of the ice sheet) and boreholes in Greenland show that subglacial channels ameliorate the speedup caused by water delivery to the base of the ice sheet in the short term. By mid summer, however, the channels stabilize and are unable to grow

any larger. The researchers' observations identify a previously unrecognized role of changes in hydraulically isolated regions of the bed in controlling evolution of subglacial drainage over summer

<http://www.lanl.gov/discover/news-release-archive/2014/October/10.01-greenlands-ice-sheets.php>

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